REMARKS

Claims 1 - 8 have been amended, and claims 11 - 17 have been added in order to more particularly point out, and distinctly claim the subject matter to which the applicant regards as his invention. It is believed that this Amendment is fully responsive to the Office Action dated November 30, 2001.

Attached hereto is a marked-up version of the changes made to the claims 3, 4 and 7 by the current amendment. The attached page is captioned "**Version with markings to show changes made**."

Claims 1 - 8 are currently pending in this patent application, claims 9 and 10 having been withdrawn as being non-elected claims in our Response to the Restriction Requirement filed October 3, 2001. As indicated above, claims 11 - 17 have been added.

In response to the Examiner's request, as set forth in item 2, page 2 of the outstanding Action, the applicant respectfully submits herewith partial translations of the German Patent Publication No. DE 35 22 427. It is respectfully noted that a copy of the German Patent Publication was submitted in the applicant's Information Disclosure Statement filed on July 24, 2000.

Claim 3 has been objected to for being in improper dependent form, as specifically explained in item 3, pages 2 and 3 of the outstanding Action. The applicant respectfully requests reconsideration of this objection.

As indicated above, claim 3 has been amended in order to more particularly point out, and distinctly claim the subject matter to which the applicant regards as his invention, and in order to correct the above-noted objection thereof. It is further respectfully noted that claim 3 has been amended in line with the applicant's description set forth in lines 2 - 7, page 17 of the applicant's specification, and thus now meets the requirement set forth in 37 CFR 1.75(c).

Accordingly, the withdrawal of the outstanding objection to claim 3 is in order, and is therefore respectfully solicited.

Claims 1 - 7 stand rejected under 35 USC §112, second paragraph, for the specific reasons set forth in item 5, page 3 of the outstanding Action. The applicant respectfully request reconsideration of this rejection.

As indicated above, claims 1 - 8 have been amended in order to more particularly point out, and distinctly claim the subject matter to which the applicant regards as his invention, and in order to correct certain informalities therein, including those pointed out by the Examiner.

Also, the applicants respectfully submit that the lack of a comma (,) has been corrected, such correction defining that feedstock gas, metal containing gas and nitrogen containing gas are different from each other, and they are independent from each other.

As to the merits of this case, the following rejections are set forth:

1) claims 1 - 5 and 8 stand rejected under 35 USC §102(b) as being anticipated by Lu (European Patent Publication No. EP 0 840 363 A1); and

2) claims 6 and 7 stand rejected under 35 USC §103(a) based on Lu in view of Akahori (European Patent Publication No. EP 0 536 664 A1).

The applicant respectfully requests reconsideration of these rejections.

First, Lu teaches plasma enhanced chemical vapor deposition (PECVD). The applicant's instant claimed invention discloses a process by heat CVD method.

The applicant thus respectfully submits that not all of the claimed features, as now set forth in claims 1 - 5 and 8, are found in exactly the same situation and united in the same way to perform the identical function in Lu's process. Thus, there can be no anticipation under 35 USC 102(b) of the applicants' claimed invention, as now set forth in claims 1 - 5 and 8, based on the teachings of Lu.

Accordingly, the withdrawal of the outstanding anticipation rejection under 35 USC 102(b) is in order, and is therefore respectfully solicited.

Secondly, Lu discloses that a reaction for forming WN_x using WF_6 gas, H_2 gas and N_2 gas, and a reaction for forming WSi_xN_x using the above described gases and SiH_4 gas in addition (see, column 3, lines 12 - 55 in Lu). However, the reaction formula described in Lu is caused in a reaction by the PECVD method: and the structure of chemical reaction is different from a heat CVD method. Although N_2 gas has reactivity for the PECVD method, N_2 is a very inert gas, and N_2 is not pyrolyticed by about 1000 °C, and does not react to other materials. N_2 is employed as a career gas of material gas or diluent gas for a heat CVD method because one of the reasons for such employment is the property of thermostability N_2 gas does not have reactivity for a heat CVD method. Therefore, N_2 gas is employed as a diluent gas in the applicant's claimed invention (see, the applicant's specification, page 20, lines 16 and 17). Accordingly, N_2 is not included in "a reductive nitrogen-containing gas comprising a nitrogen atom" of the applicant's instant claimed invention.

The applicant's claimed invention, as set forth in added claims 11 - 17, is directed to a process for using NH_3 gas and a reductive Si-containing gas. The combination of gas, as set forth in, e.g., claims 9 - 15, is not disclosed in Lu.

In addition, in the PECVD method, a product produced in the vapor-phase physically fall and lie on the substrate. The coverage is deteriorated as in the sputtering method, in general; and it is not suitable to uniformly deposit a barrier film in a contact hole or groove having high aspect ratio (more than 5). (See, JPA10-209073[005], as attached.)

In a heat CVD method of the applicant's instant claimed invention, material gas does not react in a vapor-phase so that the material gas is provided in the holes having high aspect ratio; and film is formed by surface reaction. It is possible that relatively good step coverage is obtained by a heat CVD method of the applicant's claimed invention.

The secondary reference of Akahori does not supplement the above-discussed deficiencies of the primary reference of Lu in failing to fully meet the applicant's claimed invention. Thus, even if, *arguendo*, the teachings of Lu and Akahori can be combined in the manner suggested by the Examiner, such combined teachings would still fall far short in fully meeting the applicant's claimed invention, as now set forth in the claims submitted herewith.

In view of the above, a person of ordinary skill in the art would not have found the applicant's claimed invention, as now set forth in claims 1 - 17, obvious under 35 USC §103(a) based on Lu and Akahori, singly or in combination.

Accordingly, the withdrawal of the outstanding obviousness rejection under 35 USC §103(a) based on Lu in view of Akahori (European Patent Publication No. EP 0 536 664 A1) is in order, and is therefore respectfully solicited.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the applicants undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, the applicant respectfully petitions for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully Submitted,

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PATENT TRADEMARK OFFICE

Enclosures: (1) Version with markings to show changes made
(2) DE 35 22 427 A1 (w/ partial translations)
(3) JPA 10-209073 (w/ partial translation)

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VERSION WITH MARKINGS TO SHOW CHANGES MADE 09/504,923

IN THE CLAIMS:

Please amend claims 1 - 8 as follows:

1. (Amended) A process for producing a barrier film <u>by a heat CVD method</u> which comprises the steps of:

providing a substrate in a vacuum atmosphere;

introducing a feedstock gas having a high temperature-melting point metal in its structure<u>,</u> and a reductive nitrogen-containing gas comprising a nitrogen atom into said vacuum atmosphere; and

forming a [thin] film of the nitride of said high temperature-melting point metal on said substrate[;]<u>,</u>

wherein a nitrogen-free auxiliary reductive gas is introduced into said vacuum atmosphere.

2. (Amended) The process for producing a barrier film <u>by the heat CVD method</u> according to claim 1, which comprises a step of introducing said auxiliary reductive gas together with said feedstock gas and said reductive nitrogen-containing gas into said vacuum atmosphere.

3. (Amended) The process for producing a barrier film <u>by the heat CVD method</u> according to claim 2, which <u>further</u> comprises a step of introducing said feedstock gas and said

[reductive nitrogen containing gas] auxiliary reductive gas into said vacuum atmosphere without introducing said [auxiliary reductive gas] reductive nitrogen-containing gas.

4. (Amended) The process for producing a barrier film by the heat CVD method according to claim 2, wherein, in the step of introducing said auxiliary reductive gas together with said reductive nitrogen-containing gas and said feedstock gas[:], said reductive nitrogen-containing gas is introduced at a flow rate once or more higher than the flow rate of said feedstock gas, and said auxiliary reductive gas is introduced at a flow rate once or more but not more than 10 times higher than the flow rate of said reductive nitrogen-containing gas.

5. (Amended) The process for producing a barrier film by the heat CVD method according to claim 1, wherein, in the step of introducing said auxiliary reductive gas together with said reductive nitrogen-containing gas and said feedstock gas[:], said reductive nitrogen-containing gas is introduced at a flow rate once or more but not more than 5 times higher than the flow rate of said feedstock gas, and said auxiliary reductive gas is introduced at a flow rate 2 times or more but not more than 10 times higher than the flow rate of said reductive nitrogen-containing gas.

6. (Amended) The process for producing a barrier film by the heat CVD method according to claim 2, wherein, in the step of introducing said auxiliary reductive gas together with said reductive nitrogen-containing gas and said feedstock gas[:], said auxiliary reductive gas

is introduced at a flow rate once or more but not more than 15 times higher than the flow rate of the feedstock gas having said high temperature-melting point metal.

7. (Amended) The process for producing a barrier film by the heat CVD method according to claim 1, wherein, in the step of growing the [thin] film of the nitride of said high temperature-melting point metal[:], a diluent gas not reacting with said high temperature-melting point metal and a gas having an oxygen atom in its chemical structure are introduced so that he pressure of said vacuum atmosphere is regulated to 1 Pa or more but not more than 100 Pa.

8. (Amended) A process for producing a barrier film by the heat CVD method for forming a barrier film made of a [thin] film of the nitride of a high temperature-melting point metal on a substrate, wherein[:] the surface of said substrate is exposed to a plasma of hydrogen gas and a plasma containing at least one gas selected from among argon, nitrogen and helium gases, and then the [thin] film of the nitride of said high temperature-melting point metal is formed on the surface of the substrate.

Please add claims 11 - 17 as follows:

11. A process for producing a barrier film which comprises the steps of:

providing a substrate in a vacuum atmosphere;

introducing a feedstock gas having a high temperature-melting point metal in its structure, and a NH_3 gas into said vacuum atmosphere; and

forming a film of the nitride of said high temperature-melting point metal on said substrate,

wherein a reductive Si-containing gas is introduced into said vacuum atmosphere.

12. The process for producing a barrier film according to claim 11, which comprises a step of introducing said reductive Si-containing gas together with said feedstock gas and said NH_3 gas into said vacuum atmosphere.

13. The process for producing a barrier film according to claim 12, which further comprises a step of introducing said feedstock gas and said reductive Si-containing gas into said vacuum atmosphere without introducing said NH_3 gas.

14. The process for producing a barrier film according to claim 12, wherein, in the step of introducing said reductive Si-containing gas together with said NH_3 gas and said feedstock gas, said NH_3 gas is introduced at a flow rate once or more higher than the flow rate of said feedstock gas, and said reductive Si-containing gas is introduced at a flow rate once or more but not more than 10 times higher than the flow rate of said NH_3 gas.

15. The process for producing a barrier film according to claim 11, wherein, in the step of introducing said reductive Si-containing gas together with said NH_3 gas and said feedstock gas, said NH_3 gas is introduced at a flow rate once or more but not more than 5 times

higher than the flow rate of said feedstock gas, and said reductive Si-containing gas is introduced at a flow rate 2 times or more but not more than 10 times higher than the flow rate of said NH_3 gas.

16. The process for producing a barrier film according to claim 12, wherein, in the step of introducing said reductive Si-containing gas together with said NH_3 gas and said feedstock gas, said reductive Si-containing gas is introduced at a flow rate once or more but not more than 15 times higher than the flow rate of the feedstock gas having said high temperature-melting point metal.

17. The process for producing a barrier film according to claim 11, wherein, in the step of growing the film of the nitride of said high temperature-melting point metal, a diluent gas not reacting with said high temperature-melting point metal and a gas having an oxygen atom in its chemical structure are introduced so that the pressure of said vacuum atmosphere is regulated to 1 Pa or more but not more than 100 Pa.